

MATERIAL SAFETY DATA SHEET

SRM Supplier: National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Mail Stop 2321
Gaithersburg, Maryland 20899

SRM Number: 3101a
MSDS Number: 3101a
SRM Name: Aluminum Standard Solution
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MSDS Coordinator: Mario Cellarosi
Phone: (301) 975-6776
ChemTrac: 1-800-424-9300

FAX: (301) 926-4751
E-mail: SRMMSDS@nist.gov

SECTION I. MATERIAL IDENTIFICATION

Material Name: Aluminum Standard Solution

Description: SRM 3101a is a single element solution prepared gravimetrically to contain a nominal 10 mg/mL (or 10 mg/g) of aluminum with a nitric acid volume fraction of 10 %.

Other Designations: **Aluminum** in **Nitric Acid** (aqua fortis; hydrogen nitrate; azotic acid; engravers acid); **Aluminum Nitrate*** (aluminum trinitrate; aluminum (III) nitrate; nitric acid aluminum salt; aluminum nitrate anhydrous) in **Standard Solution**

Name	Chemical Formulas	CAS Registry Numbers
Nitric Acid	HNO ₃	7697-37-2
Aluminum Nitrate	Al(NO ₃) ₃	13473-90-0
Aluminum	Al	7429-90-5

DOT Classification: Nitric Acid, Solution, UN2031

Manufacturer/Supplier: It is available from a number of suppliers.

*The addition of aluminum to nitric acid, along with other intermediate chemical reactions, forms aluminum nitrate, which will precipitate upon evaporation or drying of the solution.

SECTION II. HAZARDOUS INGREDIENTS

Hazardous Components	Nominal Concentration (%)	Exposure Limits and Toxicity Data
Nitric Acid	10	ACGIH TLV-TWA: 2 mg/kg or 5 mg/m ³
		OSHA TLV-TWA: 2 mg/kg or 5 mg/m ³
		Human, Oral: LD _{LO} : 430 mg/kg
Aluminum Nitrate	7.9	ACGIH TLV-TWA: 2 mg/kg or 5 mg/m ³
		OSHA TLV-TWA: 2 mg/kg
		Rat, Oral: LD ₅₀ : 3654 mg/kg
		Rat, Intraperitoneal: LD ₅₀ : 281 mg/kg
Aluminum	1	OSHA TLV-TWA: 5 mg/m ³ (respirable particulate)
		OSHA TLV-TWA: 15 mg/m ³ (total particulate)
		Rat, Oral: LD ₅₀ : > 5000 mg/kg

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

Nitric Acid	Aluminum Nitrate	Aluminum
Appearance and Odor: a white to slightly yellow liquid that darkens to a brownish color upon aging and exposure to light; pungent odor	Appearance and Odor: a colorless to white solid	Appearance and Odor: an odorless, white to gray solid or powder
Relative Molecular Mass: 63.02	Relative Molecular Mass: 213.01	Relative Atomic Mass: 26.98
Density: 1.0543 (10 % nitric acid)	Density: > 1	Density: 2.702
Solubility in Water: soluble	Solubility in Water: soluble	Solubility in Water: reacts with water
Solvent Solubility: decomposes in alcohol	Solvent Solubility: soluble in alcohol; slightly soluble in acetone, ethyl acetate, and pyridines	Solvent Solubility: soluble in hydrochloric acid and sulfuric acid

Note: The physical and chemical data provided are for the pure components. Physical and chemical data for this aluminum/nitric acid solution **DO NOT** exist. The actual behavior of the solution may differ from the individual components.

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Method Used: N/A

Autoignition Temperature: N/A

Flammability Limits in Air (Volume %): **UPPER:** N/A
LOWER: N/A

Unusual Fire and Explosion Hazards: Although nitric acid does not burn, it is a powerful oxidizing agent that can react with combustible materials to cause fires. Aluminum dust/air mixtures may ignite or explode. Aluminum nitrate is a negligible fire hazard. Aluminum Nitrate is an oxidizer and may ignite on contact with combustible materials.

Extinguishing Media: Use extinguishing media that is appropriate to the surrounding fire. Use a water spray from a safe distance to dilute nitric acid and to absorb liberated oxides of nitrogen.

Special Fire Procedures: Fire fighters should wear a self-contained breathing apparatus (SCBA) with a full-face piece in the pressure demand or positive mode and other protective clothing.

SECTION V. REACTIVITY DATA

Stability: X Stable Unstable

Conditions to Avoid: Avoid contact with incompatible materials.

Incompatibility (Materials to Avoid): Keep nitric acid away from organic materials, plastics, rubber, and some forms of coatings. Nitric acid is incompatible with chlorine and metal ferrocyanide. Aluminum nitrate is incompatible with combustible materials, metals, metal salts, reducing agents, and acids. Aluminum is incompatible with acids, combustible materials, oxidizing materials, metals, metal salts, bases, metal oxides, halogens, reducing agents, halo carbons, peroxides and metal carbides.

See Section IV "Unusual Fire and Explosion Hazards".

Hazardous Decomposition or Byproducts: Hazardous decomposition of nitric acid and/or aluminum nitrate can produce various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO₂), nitrous oxide (N₂O), as well as nitric acid mist or vapor. Thermal decomposition of aluminum may release toxic and/or hazardous gases.

Hazardous Polymerization _____ **Will Occur** _____ **X** **Will Not Occur**

SECTION VI. HEALTH HAZARD DATA

Route of Entry: _____ **X** **Inhalation** _____ **X** **Skin** _____ **X** **Ingestion**

Health Hazards (Acute and Chronic):

Nitric Acid: Nitric acid may be fatal if inhaled, swallowed, or absorbed through the skin. This material causes burns and is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. Inhalation may be fatal as a result of spasm, inflammation, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Aluminum Nitrate: Inhalation of high concentrations of aluminum nitrate may cause irritation to the mucous membranes with sore throat, coughing, and shortness of breath. Skin contact may cause irritation with redness and pain. Repeated or prolonged contact with irritants may cause *dermatitis*. Aluminum salts are suspected to be skin sensitizers; however, allergic sensitivity is exceedingly rare. Eye contact with aluminum nitrate may cause mild to severe irritation depending on the duration of contact. Symptoms may include redness, pain, blurred vision, and possibly burns. Repeated or prolonged contact with irritants may cause *conjunctivitis*.

Ingestion of soluble metal salts such as aluminum nitrate, may cause a burning pain in the mouth and throat, vomiting, diarrhea, *tenesmus* (a distressing but ineffectual urge to evacuate the rectum or bladder), *hemolysis* (a lysis of red blood cells with liberation of hemoglobin), *hematuria* (the presence of blood or blood cells in the urine), kidney damage, *anuria* (the absence or defective excretion of urine), liver damage with *jaundice*, *hypotension*, weakness, collapse, and convulsions. On rare occasions, the inorganic nitrates may be converted to nitrites by nitrate-reducing bacteria in the digestive tract resulting in *methemoglobinemia*. Repeated ingestion of small amounts may cause weakness, depression, headache, and mental impairment.

Aluminum: Inhalation of aluminum dust or powder may cause irritation with coughing and shortness of breath. Exposure to freshly formed fumes of aluminum may result in *metal fume fever*, an influenza-like illness. Symptoms may be delayed 4 to 12 hours and begin with a sudden onset of thirst and a sweet, metallic, or foul taste in the mouth. All symptoms usually subside within 24 hours to 36 hours.

Prolonged or repeated exposure to large concentrations of fine dust may cause *emphysema*. In sensitive individuals, aluminum may exacerbate *asthma*.

Skin contact with aluminum may cause irritation by abrasion. Chronic exposure may cause *dermatitis* with itching. Rarely, sensitization reactions have been reported. Vascular changes in the skin and congestive numbness of the fingers have been reported from occupational exposure. Eye contact with aluminum may cause irritation due to abrasion and *corneal necrosis* (localized death of living tissue of the cornea).

Ingestion of large doses of aluminum may cause gastrointestinal irritation. Aluminum is poorly absorbed and may decrease absorption of other substances.

Medical Conditions Generally Aggravated by Exposure: Kidney and respiratory disorders. Elevated aluminum levels have been associated with *Alzheimer's disease*, *neurofibrillary degeneration*, and *anemia*.

Listed as a Carcinogen/Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	_____	<u>X</u>
In the International Agency for Research on Cancer (IARC) Monographs	_____	<u>X</u>
By the Occupational Safety and Health Administration (OSHA)	_____	<u>X</u>

EMERGENCY AND FIRST AID PROCEDURES:

Skin Contact: Remove contaminated shoes and clothing. Rinse affected area with large amounts of water followed by washing the area with soap and water. Watch for chemical irritations and obtain medical assistance if necessary.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 min. Obtain medical assistance.

Inhalation: If inhaled, move the victim to fresh air. If breathing is difficult, give oxygen; if the victim is not breathing, give artificial respiration by qualified personal. Obtain medical assistance if necessary.

Ingestion: If ingestion occurs, wash out mouth with water. **DO NOT** induce vomiting. Obtain medical assistance immediately.

Note (Nitric Acid): Wash affected skin areas with 5 % solution of sodium bicarbonate (NaHCO_3). If ingested, the risk versus the benefit of the passage of a naso-gastric tube is debatable. Activated charcoal is of no value. **DO NOT** give the exposed person bicarbonate to neutralize the material.

TARGET ORGAN(S) OF ATTACK: **Nitric Acid:** skin, teeth, eyes, and upper respiratory tract
Aluminum and Aluminum Nitrate: liver, kidneys, and respiratory system

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material Is Released or Spilled: Notify safety personnel of spills. Surfaces contaminated with spills should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation or destruction.

Waste Disposal: Follow all federal, state, and local laws governing disposal.

Handling and Storage: Provide general and local explosion proof ventilation systems to maintain airborne concentrations below the TLV. Provide approved respiratory apparatus for non-routine or emergency use. Use an approved filter and vapor respirator when the vapor or mist concentrations are high. Wear chemically resistant gloves and chemical safety glasses/face shield where contact with the liquid or high vapor concentrations may occur. An eye wash station and washing facilities should be readily available near handling and use areas. Wash exposed skin areas several times a day with soap and warm water.

Note: Contact lenses pose a special problem; soft lenses may absorb irritants and all lenses concentrate them. **DO NOT** wear contact lenses in the laboratory.

Store this material at room temperature.

SECTION VIII. SOURCE DATA/OTHER COMMENTS

Sources: MDL Information Systems, Inc., MSDS *Aluminum*, 20 June 2003.
MDL Information Systems, Inc., MSDS *Aluminum Nitrate*, 19 March 2003.
MDL Information Systems, Inc., MSDS *Nitric Acid*, 19 March 2003.
The Merck Index, 11th Ed., 1989.
The Sigma-Aldrich Library of Chemical Safety Data, Ed. 11, 1988.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data on the MSDS. The certified values for this material are given on the NIST Certificate of Analysis.